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Voice at the Point of Maintenance (POMx)

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ABSTRACT

The challenges associated with providing maintenance technicians all of the information they require to accomplish their jobs has not measurably improved in the last twenty years. In 1990 the Air Force Research Laboratory (AFRL) began conducting research on this front and in 1992 demonstrated a system which has been embraced by many as a solution, an Integrated Maintenance Information System (IMIS). They brought the Interactive Electronic Technical Manual (IETM), along with the ability to report and receive failure data and the ability to order parts, out to the technician at his job site, at the aircraft, on the flight line. This abstract describes how voice technology plays a key role in overcoming many of the obstacles preventing real time data access at the Point of Maintenance (POMx).

Evaluations conducted by the AFRL have shown that voice recognition technology has matured to an extent that it can now be used by a technician to transfer information directly to and from a computer system. The advancements are such that the technician does not have to train the system as is common in many COTS voice packages. Using a simple communicative device (i.e., FM Radio, RF Headset, or other microphones), the technician can now open/close jobs, order parts, report or query for status and "listen" to the inspection checklist, as opposed to being hamstrung by a hand-held technical manual.

Using an RF microphone and headset allows the maintenance technician complete hands-free movement in the work environment, without the constraints of carrying paper technical data, a portable computer or even a hard wire attached to a computer. The system actually "reads" to the technician the technical data inspection steps and it can communicate back to them whether that step passed or failed. The system interfaces (i.e., stores, forwards and receives) with legacy maintenance data collection systems using the existing DISA infrastructure. A system with most of these capabilities has been successfully incorporated on the E&I portion of the F-15 PDM line at Robins AFB, immediately reducing the inspection process time by 33%.

The FM radio voice recognition system is being used to capture aircraft status by passively monitoring FM radio transmissions. The radios can also be used to open and close jobs and order parts. A by-product of the voice recognition technology is the ability of the system to automatically convert spoken words to the appropriate work unit code, when discovered and how malfunction code, thereby eliminating "dirty data" errors at the source.

The primary advantages of using voice recognition at POMx are; 1) more timely availability of aircraft status provided by passive real-time data collection, 2) reduction / elimination of data entry errors by improving the man-machine interface, 3) reduction / elimination of data latency problems by bringing the data entry locale out to the point of maintenance, and 4) more productive utilization of personnel by relieving them from lengthy keyboard data entry / research taskings. Yesterday's requirement for technicians to curtail all activities lead time away from shift's end (so as to document those activities) is no longer required. Having to remember a full day's worth of maintenance data information for data entry at the end of a shift is no longer a factor with the implementation of voice. Further, security and infrastructure constraints aren't a concern with FM Net as it is already in the field and meets all security and deployment requirements.

Current State of Voice POMx

Introduction

The majority of data contained in legacy systems are considered by many to be inaccurate and typically inaccessible by technicians at the POMx. There are several factors that complicate this problem, namely that there are numerous disparate systems and a proliferation of entry errors, including outright omissions and the latency of data entry. Furthermore, high operational tempo, geographical separation from the unit, fewer technicians and an inability to leave the work sight to conduct proper research compound the affects. Providing technicians the capability to capture pertinent maintenance data passively at the POMx will increase the accuracy and timeliness of the data. Using voice recognition technology to autonomically convert verbal utterances to the correct aircraft maintenance work unit codes (WUCs) and how malfunction codes (i.e., –06 code manuals) increases data accuracy and aids in capturing diagnostic data required by all levels of repair.

What is Voice POMx?

Voice POMx is a voice-enabled, hands-free maintenance tool that allows flightline maintainers to passively input and receive aircraft maintenance information using existing FM radios, desktop personal computers or radio frequency (RF) personal display assistants (PDA). The product currently supports opening jobs, ordering parts and closing jobs associated with unscheduled, on-equipment, flightline maintenance tasks.

Voice POMx is a web-enabled, java-based client-server application designed to run on existing base infrastructure. Information is passively collected, displayed to a user for review and update as necessary, and then transparently sent to CAMS. CAMS returns the requested information or the applicable error message. The product allows the user to update the information and resubmit it to CAMS. Approved single session security is used with CAMS. All information is available for display using either Netscape ™ or Internet Explorer ™.

The Voice Engine

The voice recognition engine is speaker independent and does NOT require voice training. It accurately recognizes FM net transmissions in noise environments less than 90dB, which equates to the normal flightline environment. Up to 95dBs can be achieved using directional microphones. Ear microphones used in conjunction with ear protection are expected to achieve in the area of 120dBs. Note: The next release of the KLSS voice engine is expected to achieve a minimum of 100dBs using just FM radios. This equates to engine and AGE operational environments.

Legacy System Interface

Access™ is used as a temporary data store for job and part information supporting the voice engine. Once a job is closed, it no longer resides in the temporary data store. InfoConnect ™ is used to transfer this information to and from CAMS unbeknownst to the user. However, the legacy system interface component has been developed in isolation from the rest of the application, allowing for easy migration to future SSG Software Factory architectures such as XML.

Advantages of Voice Recognition

The primary advantages of using voice recognition at the POMx are; 1) more timely availability of aircraft status provided by passive real-time data collection, 2) reduction / elimination of data entry errors by improving the man-machine interface, 3) reduction / elimination of data latency problems by bringing the data entry locale out to the point of maintenance, and 4) more productive utilization of personnel by relieving them from lengthy keyboard data entry / research taskings. Yesterday's requirement for technicians to curtail all activities lead time away from shift's end (so as to document those activities) is no longer required. Having to remember a full day's worth of maintenance data information for data entry at the end of a shift is no longer a factor with the implementation of voice. Further, security and infrastructure constraints aren't a concern with FM Net as it is already in the field and meets all security and deployment requirements.

Voice Hardware/Software Requirements

Voice POMx operates within the Windows 2000 or NT environments and currently requires a minimum of 256 MB of RAM to effectively operate (individual user requirements may vary). It is currently used on or in conjunction with the Motorola AstroSabre™ and XTS 3000™ radios and the Fujitsu Pencentra 200™. At a minimum, continued testing is projected to continue on the Compaq IPAQ™ pocket PC.

Future Voice POMx

Introduction

To often information required to make correct decisions on a failed end-item / component is not available. Today's legacy system technical orders are primarily paper-based. At best they reside at the lower levels of digitization and, consequently, cannot provide for the capture or display of real-time maintenance data as an integral part of the maintenance process (as would be provided by a class 4 or 5 IETM) nor do they support display on new technology devices. If while troubleshooting a system malfunction, a technician were presented with the conditions necessary to cause a specific failure while still at the POMx, they could successfully isolate the failed component the first time. They wouldn't be forced into waiting until a repeat or recur condition existed, or until the system could be checked out during the next flight, or until a Bench Check could be performed on a test station before they were certain they had identified the true "bad actor". Comprehensive and valid information provided to the user at the POMx reduces / eliminates the wasteful expenditure of man-hours spent processing / working serviceable parts, the subsequent unnecessary burden on supply, cannibalization actions in general and, inevitably, will improve mission readiness.

Where are we today?

The critical task is to integrate the latest voice technologies to capture, access and manipulate logistics data at the POMx. The latest technologies (both hardware and software), which readily support the implementation of a voice recognition system, are not supported by the existing Air Force infrastructure. An ideal hands-free and passive collection and presentation environment doesn't exist and should include various tools. One tool would provide the user both visual feed-back manipulated / controlled by voice input as well as feed-back characterized by the audible presentation of steps / information used for performing the task at hand. To improve overall

diagnostic capabilities with emphasis on verticality of test, diagnostic data from organizational maintenance must be passed near real-time to back shop and depot test station databases. Currently, this does not occur nor is broad scale growth in this direction on the immediate horizon.

Where do we need to go?

Before a technician can troubleshoot a malfunction, whether at a test station, engine or an aircraft, they could use a Voice POMx system to verbally request a solution set based on historical data. This data would include; debrief and parametric flight data, test station, depot and Original Equipment Manufacture (OEM) repair data. Historical analyses such as these would assist the user by providing built-in-test, false alarm and could not duplicate (CND) trends, as well as the repair history for the particular system or part. Analysis could also provide a recommended solution along with procedures to accomplish the repair / task no matter what the level of repair.

Improved verticality of testing requires the visibility of accurate and near real-time maintenance failure data. This all starts with the capturing of aircraft diagnostic data and debrief information as early in the process as possible—preferably before the aircraft even lands. Weapon systems have attempted several methods to capture this data and load it into the debrief system. Implementing Voice POMx at the aircraft, or as part of a standard debriefing system, can aid in the capture and sharing of this data. A Voice POMx system can perform analysis based on data input and then present a flight crew with questions required to build the solution set for the technician.

What about tech data?

There is also a need to change how current maintenance instructions are presented to technicians. Solution sets unique to a repair task that are compiled from engineering and failure analysis will reduce unnecessary maintenance actions. These analyses must be dynamic, and encompass not only trending associated with built-in-test and false alarms, but account for the inevitable aging of our systems. This mandates that we possess a class of TO, and associated support infrastructure, which, by its very nature, is conducive to rapid and pervasive changes. Legacy TOs, along with their current sustainment approach, cannot react quickly enough to account for rapidly changing solution sets and the subsequent repair instructions born by them. The utilization of legacy TOs does not support pushing frequent updates to a weapon system's database to ensure proper maintenance actions occur. Further, the presentation of this data must not only provide a precise solution set and instructions for the specific level of maintenance, but still account for the safety of the user via the incorporation of the appropriate cautions and warnings. Implementation of dynamically created solution sets, and the subsequent need for tech data to support these solution sets, requires we move away from the traditional technical order presentation formats seen today.

The Vision

The integration of dynamic solution sets with advancements in TO formatting and sustainment infrastructure, coupled with the efficiencies provided by Voice POMx, will act as a force / personnel multiplier. The visible resultant of this being an apparent reduction in manpower requirements at both organizational and intermediate level maintenance. Additionally, there will

be a reduction in the current supply shortfalls supported by improvements in the overall repair cycle and the capability to accurately isolate malfunctions the first time.

BIOGRAPHY

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Greg Greening received an Associate Degree in Aircraft Systems Technology from the Community College of the Air Force and a Bachelor of Science Degree in Management from Park University. Greg is currently a Field Engineer supporting voice recognition efforts and the project manager of autonomic logistics development programs within KLSS. Greg spent 20 years in the Air Force and held several jobs within the F-111 and F-15 maintenance complex including electrician, avionics technician, crew chief, expediter and production supervisor. He also worked system acquisition, design, development, test and evaluation for nine years in the F-15 SPO and Headquarters ACC. During this period he worked primarily in the maintenance, diagnostic and supportability disciplines.